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IN-LINE ROLLER SKATE WITH ANTI-LOCK BRAKE

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FIELD OF THE INVENTION

1. The described invention relates to in-line roller skates, which have their wheels in tandem, and more particularly to an anti-lock, one-way braking wheel for such skates.

BACKGROUND OF THE INVENTION

2. It is well known by those skilled in the art of skating that the safest, most effective way to stop on skates is to turn to the backward skating direction and lean forward onto a braking device on the front of the skates. For many years this has been accomplished on figure roller skates with a toe stop (a piece of rubber mounted on the front of the boot or frame just above the skating surface) and on figure ice skates with a "pick" on the front of ice skate blades. However, it is also well known by those skilled in the art of designing wheeled vehicles that the most effective braking is accomplished by maintaining rolling contact with the ground surface. This is because the static friction (rolling contact) between most surfaces is up to 35 percent higher than the kinetic friction (skidding contact) between the same two surfaces. Also, if the braking wheel locks and quits turning, the abrasive skating surface will quickly wear a flat spot on the wheel, thus reducing the service life of the wheel.

3. Patents 5,135,244 to Allison, 5,342,071 to Soo, 5,486,011 to Nelson, 5,551,172 to Repucci all share similar principles of operation. These patents utilize the approach

that while skating backward the heel of the boot can be raised putting enough weight on the front wheel to force it up against a brake surface located above it, causing a braking effect directly proportional to the weight applied to the wheel. These prior art front wheel braking devices share a dangerous safety hazard with the common toe stop referred to above. When skating forward on bumpy surfaces, playing a contact sport such as hockey, or coming into contact with other skaters, a skater can be forced up on the front wheel of one or both skates, which could cause inadvertent application of the brakes and potentially topple the skater. This is the primary reason that hockey skates do not have toe stops or picks.

4. Accordingly, the need exists for an in-line roller skate having a front braking wheel that will roll, without skidding, to a rapid stop on most skating surfaces in the backward skating direction when the maximum braking force is applied, but will not function as a brake if accidentally applied in the forward skating direction.

5. Another disadvantage of prior art in-line roller skates is also apparent. Figure skating on in-line roller skates has recently gained some popularity because of its similarity to figure skating on ice skates. Jumps can be performed on in-line skates with much the same ease as on ice skates, however spins are very difficult and cannot be performed with the speed and duration that can be accomplished on ice skates. For many years long duration high speed spins have been performed on conventional roller skates of the type having two wheels mounted in a truck (the steering mechanism) on both the front and rear of the skate. Those skilled in the art of figure skating on these conventional skates can shift their weight up to the front two wheels and over to one side of the skate which, due to the action of the truck, lifts one of the rear wheels slightly off the skating surface. A spin is then accomplished by sliding the other rear wheel around and around the front wheels that are rolling around each other or

pivoting, if both biased. This provides a stable, three-point platform which offers very little resistance to the spinning motion. However, the single wheel on the front of an in-line skate cannot provide the stable, three-point platform necessary for high quality spins. Accordingly, a need exists for an in-line figure skate having the capacity for spinning.

SUMMARY OF THE INVENTION

6. The present invention provides an in-line roller skate with at least one, preferably smaller, raised braking wheel in front of or in place of the front load-bearing, skating wheel. The braking wheel is preferably smaller than the skating wheels so that it can be raised up in the frame far enough to allow the skate to be tilted forward about ten degrees without applying the brake. This will allow the execution of certain desirable backward skating motions without accidentally applying the brake. By locating the front skating wheel axle just forward of the ball of the foot and the rear wheel axle just behind the heel of the boot in a three in-line skating wheel arrangement, maximum maneuverability and control can be achieved. The braking wheel is preferably slidably mounted in a vertical slotted hole in the skate frame, so that when the skate is tipped forward and weight is applied over the braking wheel, it moves upward in contact with a counter-rotatable (rotating in one direction only) braking device. Thus the braking wheel is mounted intermediate between the braking device and the skating surface such that when the skate is moving in the backward direction, and the braking wheel and the front skating wheel are in contact with the skating surface, the braking device is in sliding contact with the braking wheel at a point approximately vertically above the contact point between the braking wheel and the skating surface.

7. The counter-rotatable braking device is preferably a clutch bearing or similar ratcheting device, which is mounted on a shaft approximately ten degrees rearward from

vertically above the braking wheel in the skate frame. As is known in the art, clutch bearings, sprags, and a variety of other ratcheting devices can be oriented to allow the braking wheel to rotate freely if accidentally applied while skating forward, and still provide the desired braking action in the backward direction. The braking contact surfaces consist of the outer case of the clutch bearing or one of the other ratcheting devices against the outer perimeter of the braking wheel. While skating backward, if the braking wheel is applied the clutch bearings will not rotate, thus transmitting a consistent braking force to the braking wheel, proportional to the weight applied. If the coefficient of friction between the braking wheel and the skating surface is substantially greater than that between the braking wheel and the clutch bearing case, the braking wheel will maintain rolling traction on the skating surface, without sliding, thus providing the desired antilock braking condition. The smooth, hardened steel outer surface of the braking device is much less abrasive and has a substantially lower coefficient of friction against the braking wheel than any safe skating surface. This invention also offers the advantage of allowing the skater, while standing still (not skating in either direction), to incline the skate forward so that the braking wheel is in contact with the skating surface to accomplish rapid starts in the forward skating direction, or for resisting rearward motion of the skater, such as when the skater is pushing against other skaters in a contact sport utilizing in-line skates.

8. A second embodiment of the present invention provides an in-line skate having a pair of front braking wheels on the same rotational axis, spaced slightly apart and operating independently of each other. The remainder of the skate preferably has the same configuration as the first embodiment previously described. A high quality spin could then be achieved by placing most of a skater's weight on the braking wheels and sliding the front skating wheel around and around the braking wheels, one of which is rolling around the other.

9. A third embodiment of the present invention provides an in-line skate having a front braking wheel that is rotatably mounted on the front end of two arms which are pivotally mounted on the rear end on each side of the skate frame. Tabs protruding outward from the bottom of each side of the skate frame hold the arms and the braking wheel upward in or near contact against the braking device. The remainder of the skate preferably has the same configuration as the first embodiment previously described.

10. Broadly, in one aspect, the present invention concerns an in-line roller skate for skating on a skating surface comprising a boot for supporting the foot of a user, a frame comprising either an integral part of the sole of the boot or a separate part secured to the underside of the boot, a plurality of skating wheels rotatably mounted on the frame for rotation in a common plane, at least one counter-rotatable braking device rotatably attached to the frame comprising means to allow rotation of the device in the forward skating direction and to resist rotation in the other direction, and at least one braking wheel rotatably attached to the frame forward of the skating wheels by means for mounting the braking wheel in contact with the braking device at least when the skate is tilted forward.

11. Broadly, in another aspect, the present invention concerns an in-line roller skate for skating on a skating surface comprising a boot for supporting the foot of a user, a frame secured to the boot having a pair of parallel elongated slots in the forward portion of the frame, the slots having approximately vertical axes, a plurality of skating wheels rotatably mounted on the frame rearward of the slot for rotation in a common plane, at least one counter-rotatable braking device rotatably attached to the frame approximately in line with the axes of the slots, the braking device comprising means to allow rotation of the device in one direction and to resist rotation in the other direction, an axle slidably mounted in the slots, and at least one braking

wheel mounted on the axle, such that the braking device and the braking wheel are in a common plane of rotation and the braking wheel contacts the braking device at a point approximately vertically above the contact point between the braking wheel and the skating surface and wherein the braking device is oriented to allow rotation of the braking wheel against the skating surface in the forward skating direction and to resist rotation of the braking wheel against the skating surface in the reverse skating direction.

BRIEF DESCRIPTION OF THE DRAWINGS

12. FIG. **1** is a side view of an in-line skate with an elevated front braking wheel of the first embodiment of the present invention.

13. FIG. **2** is a side view of the front portion of the skate of FIG. **1** showing the skate tipped forward with the front skating wheel and braking wheel both contacting the skating surface, but with most of the weight of the skater bearing on the braking wheel.

14. FIG. **3** is a side view of the braking wheel and the counter-rotatable brake assembly mounted in the front of the frame of the skate of FIG. **1** showing the braking wheel in contact with the skating surface but in the unloaded condition.

15. FIG. **4** is a cross sectional view of the components of FIG. **3** through the center of the braking wheel and braking device in the same condition as FIG. **3**.

16. FIG. **5** is a cross sectional view of the front portion of an in-line skate of a second embodiment of the present invention with two elevated brake wheels.

17. FIG. **6** is a side view of an in-line skate with an elevated front braking wheel of a third embodiment of the present invention with the braking wheel mounted on pivoting arm.

18. FIG. **7** is a side view of the braking wheel, guide arms and brake assembly mounted in the front of the frame of the skate in FIG. **6** showing the braking wheel in contact with the skating surface in an unloaded condition.

19. FIG. **8** is a cross sectional view of the components of FIG. **7** through the center of the braking wheel and braking device in the same condition as FIG. **7**.

DESCRIPTION OF A PREFERRED EMBODIMENT

20. Referring to FIG. **1**, an in-line skate **10** of the first embodiment of the present invention preferably includes a boot **12**, a frame **14** mounted to the underside (sole) of the boot **12**, skating wheels **16**, **18** and **20**, rotatably mounted to the frame **14** as is well known in the art, a raised braking wheel **22**, and a brake assembly **24**. The approximately three skating wheels **16**, **18** and **20** may be of different sizes, but are preferably aligned in the same vertical plane, with rotational axes located such that all skating wheels **16**, **18** and **20** simultaneously engage the skating surface **26**. The braking wheel **22** is preferably of lesser diameter than the skating wheels **16**, **18** and **20**, and is preferably elevated with respect to the skating wheels **16**, **18**, and **20** such that when the skate **10** is tilted forward about ten degrees with the front skating wheel **20** maintaining contact with the skating surface **26**, the braking wheel **22** will not contact the skating surface **26**. This elevation of the braking wheel **22** allows the execution of certain desirable backward skating motions, while minimizing the potential for unintentionally applying the brake and thus reducing the skater's speed. Although on a prior art figure roller skate equipped with a toe stop, a forward inclination of approximately ten degrees or more is required to bring the toe stop in contact with the skating surface, as is known and appreciated in the art, substantial variations in the configuration of the skate of the present invention are possible, including the incorporation of means to allow adjustment of the size of braking wheel **22** and the location of

the braking wheel **22** with respect to the frame **14**, thus controlling the amount of forward inclination of the skate **10** required to bring the braking wheel **22** in contact with the skating surface **26.**

21. Referring to FIG. **2**, the front portion of the skate of FIG. **1** is shown in the braking position with the skate **10** rotated forward on front skating wheel **20** until most of the skater's weight is resting on wheel **22**. Wheel **22** is rotatably mounted on shaft **32**, which is slidably mounted in elongated holes (slots) **34** on both sides of frame **14**. Clutch bearing **28** is rotatably mounted on shoulder bolt **30**, which is firmly mounted in frame **14**. Clutch bearing **28** is mounted directly over wheel **22** on shaft **30** and, as well known in the art, will rotate freely in only one direction and lock onto the shaft **30** in the other direction. Bearing **28** is oriented on shaft **30** in the direction that allows wheel **22** to roll against the outer surface of bearing **28** freely in the forward skating direction regardless whether the weight of the skater is applied. The outer surface of bearing **28** is preferably a smooth durable surface, such as hardened steel, which has a high coefficient of friction against the surface of wheel **22**, but lower than the coefficient between wheel **22** and all clean, dry surfaces **26** that would be considered safe for roller skating. When the skate **10** is in the forward tilted braking position, slot **34** is approximately vertically aligned with bearing **28** and the normal forces on the top and bottom of wheel **22** and shaft **32** are equal. Therefore, when braking pressure is applied, braking wheel **22** will slide upwardly against high frictional resistance from bearing **28**, but continue to rotate without locking up on all safe skating surfaces. As the skater's weight is placed on wheel **22**, when skate **10** is tilted forward, the upper perimeter of wheel **22** starts to deform around the steel outer surface of bearing **28,** which provides an adequate braking surface for smooth controlled stops.

22. Although, as illustrated in the preferred embodiment, slot **34** has a rearward inclination of approximately ten degrees such that it is oriented approximately vertically when skate **10** is inclined forward approximately ten degrees to bring the braking wheel **22** in contact with the skating surface **26**, substantial variations in the inclination of slot **34** are possible, including the incorporation of means to allow adjustment of the amount of inclination of slot **34** to vary the initial braking force applied to wheel **22**. Also, although in the preferred embodiment the axis of slot **34** is approximately aligned with the rotational axis of bearing **28**, substantial variations in the orientation of bearing **28** in relation to slot **34** are possible, including the incorporation of means to allow adjustment of the orientation of the axis of slot **34** in relation to the rotational axis of bearing **28** for varying the maximum braking force. As is known and appreciated in the art, variations in the inclination of slot **34** and the orientation of the axis of slot **34** in relation to the rotational axis of bearing **28** will affect, and thus can be varied to control, the amount of braking force applied to wheel **22** for a given amount of weight applied over wheel **22** and a given inclination of skate 10 with respect to the skating surface **26**.

23. Braking wheel **22** is preferably selected from a group of commercially available in-line skating wheels known in the art.

24. Referring to FIG. **3**, wheel **22** is shown in contact with surface **26** but unloaded. Since bearing **28** does not act as a brake in the forward direction, wheel **22** can be biased against bearing **28** with shaft **32** in the lowest position in slot **34** to keep the shaft **32** from rattling. A common spring type wear adjuster may be installed in slot **34** to bias wheel **22** against clutch bearing **28**, if necessary, to prevent such rattling.

25. FIG. **4** is a cross sectional view of the braking wheel assembly and the clutch bearing assembly shown in FIG. **3**. Clutch bearing shaft **30** is preferably a hardened steel

shoulder bolt threaded into one side of frame **14** and tightened securely against thrust washer **36**. When shaft **30** is threaded into the correct side of frame **14**, clutch bearing **28** will torque the bolt **30** in the direction that tightens bolt **30** in the braking mode and will apply minimal torque in the other direction. Thrust washers **36** and **38** secure bearing **28** in the center of frame **14**. Wheel **22** is rotatably mounted on shaft **32** by wheel bearings **68** and **70**. Thrust washers **42** and **44** secure wheel **22** in the center of frame **14**. Machine screw **46** is tightened into the end of shaft **32** to secure the shaft in frame **14**.

26. FIG. **5** is a cross sectional view of a second embodiment with a slightly wider frame **52** in the front of the skate **10**, which allows space for two braking wheels **54** and **56**, and corresponding clutch bearings **58** and **60**. The function and assembly of each of the preferably narrow brake wheels **54** and **56** are similar to brake wheel **22** of the first embodiment. Center thrust washer **62** spaces the braking wheels **54** and **56** apart and center thrust washer **64** spaces the clutch bearings **58** and **60** apart so that each clutch bearing can operate independently upon its associated brake wheel to resist rearward rotation solely of that brake wheel. Braking wheels **54** and **56** are rotatably mounted on shaft **66** by bearings **68** and **70**, and clutch bearings **58** and **60** are rotatably mounted on shoulder bolt **72**, which is securely threaded into frame **52**. Shaft **66** is slidably secured in frame **52** through a slot **74** on both sides of frame **52**.

27. This arrangement allows a spin to be accomplished by permitting one of the braking wheels **54** or **56** to roll freely forward on the skating surface **26**, thus circling around the other braking wheel **54** or **56**, which acts as a pivot point. The pivot braking wheel is restricted from rearward rolling by its associated clutch bearing, and thus the braking wheel **54** or **56** pivots about its contact point with the skating surface **26**. In a clockwise spin the left braking wheel **56** rolls forward around the pivoting right braking wheel **54**. Conversely, in a

counterclockwise spin the right braking wheel **54** rolls about the pivot point defined by the contact point of the left braking wheel **56** with the skating surface **26**.

28. FIG. **6** is a side view of a third embodiment of the invention and similar to the first embodiment except that it uses guide arms **82** and **83** pivotally mounted on each outside surface of frame **84** to allow translation of wheel **22** in an approximately vertical direction upwards near or against clutch bearing **28**, in place of the slotted holes 34 in the first embodiment. Guide arm **83** is not visible in FIG. **6**, but may be identical in configuration to guide arm **82**. Arms **82** and **83** are pivotally mounted on axle **88** on the back end and rotatably mounted to wheel **22** through shaft **90** on the front end allowing wheel **22** to move in an approximately vertical direction toward brake assembly **24**. Alternatively, arms **82** and **83** could be pivotally mounted on pins protruding from frame **84** near axle **88** and provide the same function. Tabs **86** and **87** (not shown in FIG. **6**) protrude from each side of frame **84** and position arms **82** and **83** and wheel **22** upwards near or against brake assembly **24**. Tab **87** is not visible in FIG. **6**, but may be identical in configuration to tab **86**. The operation of skate **80** is essentially the same as skate **10** of the first embodiment.

29. Referring to FIG. **7**, **the** approximately vertical translation of the braking wheel axle **90**, supported and guided by arms **82** and **83** (not shown in FIG. **7**), is approximately in line the point of contact between the braking wheel **22** and the outer surface of clutch bearing **28** rotating about shaft **30** in frame **84**. This arrangement provides the same braking function as described for the first embodiment.

30. FIG. **8** is a cross sectional view of the components of FIG. **7** showing the arms **82** and **83** resting on the tabs **86** and **87** respectively, thus positioning unloaded braking wheel **22** upwards near or against clutch bearing **28**. Thrust washers **92** and **93** on the inside and

arms **82** and **83** on the outside secure wheel **22** on shaft **90** in the center of frame **84**. In a loaded condition, that is with the skate **80** inclined forward, thus placing weight on braking wheel **22** such that braking wheel **22** is forced upwards fully engaging clutch bearing **28**, arms **82** and **83** may be lifted above the resting position on tabs **86** and **87** respectively.

31. As is known and appreciated in the art, other embodiments with alternative means for securing braking wheel **22** upwards near or against clutch bearing **28** with the approximately vertical translational freedom of movement as provided by the slotted holes **34** in the first embodiment and by guide arms **82** and **83** in the third embodiment. For example, the approximately vertical translational freedom of movement can be provided by guide arms of material having sufficient flexibility fixedly mounted at the ends opposite the braking wheel **22** to each outside surface of frame **84** to allow translation of wheel **22** in an approximately vertical direction upwards near or against clutch bearing **28**. Alternatively, the appropriate freedom of movement can be provided by mechanisms such as forks or other axle mounting devices that are slidably mounted in approximately vertically oriented cavities, channels or tracks. It can be appreciated that any such means allowing a modest range of approximately vertical translation of the braking wheel axle without imposing substantial frictional resistance would be suitable to permit braking wheel **22**, under load, to be forced upwards fully engaging clutch bearing **28**.

32. The detailed description set forth above in connection with the appended drawings is intended as a description of a presently preferred embodiment of the invention and is not intended to represent the only forms in which the present invention may be construction and/or utilized. The description sets forth the functions and the sequence of steps for constructing and operating the invention in connection with the illustrated embodiments. However, it is to be understood that the same or equivalents functions and sequence may be

accomplished by different embodiments that are also intended to be encompassed within the spirit and scope of the invention.